

Indian Museum Notes

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INDIAN MUSEUM NOTES.

THE WILD SILK INSECTS OF INDIA.

By E. C. COTES.

The following account of the wild silk-producing insects of India is intended to be a supplement to the paper on the cultivated forms, published as Vol. I, No. 3, of these *Notes*. It includes a summary of what has been ascertained about the various forms of Saturniidæ and Bombycidæ which occur in India—the mulberry-feeding silk worms, and the *Eri*, the *Muga*, and the *Tusser* alone being omitted, as they have already been dealt with in the paper on the cultivated forms.

It is a well known fact that the caterpillars of most moths spin a small amount of silk. The only groups, however, which contain species whose silk is at all suited for utilization are the Saturniidæ and Bombycidæ, and the whole of the Indian species belonging to these groups, therefore, have been included in the present report, though many of them do not produce sufficient silk to be of any use. So much, however, has of late years been said about the wild silk insects of India, and such exaggerated opinions have been expressed as to their value, that it has been thought best to deal exhaustively with the matter, so as to clear the ground and show precisely how the question really stands.

All that is known about the possible commercial utility of the cocoons of the various species has been noticed in dealing with each insect. The conclusion arrived at has been, that while many of the wild species produce silk which would be of considerable value if it were forthcoming in sufficient quantities, there is nothing to show that any of it is superior to the silk produced by the species which are already under cultivation; and although the cocoons of numerous wild species are collected, when they happen to be found, and are sold to be spun up with other materials, this source of supply is too precarious to have any commercial importance; so that upon the whole it may be concluded that an increased demand for Indian silk is far more likely to stimulate the production of the species which are already under cultivation than to bring any of the wild forms into general use.

The only cocoons, other than those of the cultivated forms, which are to be found in any appreciable quantity in the Calcutta market, belong

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to the species *Attacus cynthia*, and even these do not appear in sufficient numbers to be of any importance. Of the remaining wild species, the most promising seem to be; (1) *Cricula trifenestrata*, whose golden colored cocoons are often to be found in large masses upon mango and other trees in many parts of India, and have been favorably reported upon by some experts, though the silk is said to irritate the skin of the wearer, owing to urticating properties of the caterpillars' hairs which are liable to get spun up with it; (2) *Antheraea roylei*, which lives upon hill oaks in the Himalayas and is closely allied to the oak feeding species *Antheraea pernyi* and *Antheraea yamamai* which produce most of what is known as the *Tussore* silks of China and Japan; (3) *Theophila huttoni*, whose cocoons are sometimes to be found in considerable number upon wild mulberry trees in the North-West Himalayas, and might occasionally be worth collecting, though, according to Captain Hutton, the crop is too precarious to have much value.

In drawing up this account constant reference has been made to the collections of the Indian Museum, which now contain representatives of all the commoner forms of Indian Saturniidae and Bombycidae. The literature of the subject has also been carefully consulted and an attempt has been made to introduce some order into it, by indicating the affinities of a number of so-called species, which have in many cases been founded solely upon trifling peculiarities detected in dried specimens, though these peculiarities are often so slight that the insects are practically indistinguishable. Where, therefore, there is no known difference in structure or life history to justify the separation of what are evidently very closely allied forms, it has been thought best to deal with them under the headings of the ones earliest described, the existence, however, of the allied forms being in each case indicated, so as to prevent the possibility of confusion arising, in the event of fundamental differences being in any cases hereafter brought to light. Figures of all the well marked forms have been appended, where possible, with illustrations of the caterpillars and cocoons; and in all cases where there is any possibility of doubt about the identity of a species which has been figured, the authority adopted for its identification has been quoted. The most reliable specimens in the Museum collection of Saturniidae and Bombycidae are probably those collected by the late Mr. Otto Möller in Sikkim and determined by Mr. H. J. Elwes, but the Museum also possesses several of the late Captain Hutton's types, as well as numerous insects determined by Mr. F. Moore, and the whole of these specimens have in each case been carefully examined, reference being also made to a considerable collection of Indian moths belonging to Colonel A. M. Lang and determined by Mr. F. Moore.

With regard to the plates with which this report is illustrated, the figures of the larvæ of *Theophila affinis*, *Th. huttoni*, and *Th. bengalensis*,

are from colored drawings made some years ago by the Museum artist, Behari Lal Dos, under the direction of the Superintendent of the Indian Museum. The figure of the cocoon of *Theophila affinis* is a photograph kindly taken by Mr. Wood-Mason. The figures of *Antheraea yamamai* and *A. pernyi* are after figures published in the Rev. et Magde Zool. and the Tijds. Voor. Ent. in illustration of papers by Guérin Méneville and Westmaas. The figure of the larva of *Ocinara lactea* is after one published in the Trans. Ent. Soc., Lond., in illustration of a paper by Captain Hutton. The remaining figures have been made from the specimens by the Museum artist, Grish Chunder Chuckerbutty, under the direction of the writer.

ATTACUS ATLAS, Linn. Plate 2, fig. 1.

This moth is well known on account of its great size, some of the specimens in the Indian Museum being more than ten inches across from tip to tip of wings. It is common on the slopes of hill ranges all over India and Burma; and, according to Gosse, ranges in South-Eastern Asia over 35° of latitude and 55° of longitude, being abundant in China and scattered over the whole of the Malay Archipelago.

The life history of the insect has been fully described by Gosse (Entomologist XII, p. 25), Manuel (Journ. Agri. Hort. Soc. Ind. n. s. Vol. VII, p. 291), and by Brownlow (Journ. Agri. Hort. Soc. Ind. n. s. Vol. V, p. 183). According to Manuel the insect spins once a year in its natural state, though in domestication in Burma it will spin twice or even three times,—once at the commencement of the rains, once during the rains, and again at the close of the rains, the best cocoons being those formed towards the beginning of the cold weather. The female moth is very sluggish, and seldom flies; the male, which has a powerful flight, usually seeking her out and fertilizing her as she clings to the cocoon from which she has emerged; for this purpose the male is furnished with some sense, probably of smell, which enables him to find the female unerringly, however thick the foliage in which she is concealed. After fertilization the female lays about 300 eggs in masses which are firmly gummed on to the under surface of the leaves upon which the caterpillars afterwards feed. The food plants are very numerous; in Almorah the caterpillar has been found upon a bush belonging to the genus *Berberis*; in the hills about Mussoorie upon *Falconeria insignis* (Hutton); in Assam on *Vangueria spinosa* (Stack); in Sikkim upon *Teucrium macrostachyum*, a species which grows abundantly from an elevation of 6,000 feet upwards (Otto Möller); in Bangalore upon a species of *Ocimum* (Cameron); in Burma upon *Ardisia* sp., *Clerodendron infortunatum*, *Dillenia pentagynia*, *Lagerstræmia indica*, *Nauclea rotundifolia*, *Phyllanthus emblica*, and *Schleichera trijuga* (Manuel); while Gosse succeeded in rearing it upon apple, and in Ceylon the form

described by Moore as *Attacus taprobanis*, which is said to be very common about Colombo, feeds upon cinnamon (Thwaites).

The eggs are oval in shape, about 0.08 of an inch in diameter, in color greenish white, with brownish purple clouding, which readily washes off. They hatch about a week after being laid, and the caterpillars which emerge are generally sluggish and solitary in their habits, seldom wandering to any distance from their birthplace unless driven by scarcity of food. When first hatched they are little dark colored creatures, about a third of an inch in length, and covered with hairy tubercles; they grow rapidly, however, and after the first molt become lighter in color and are soon covered with a dense white flour-like secretion which accumulates upon them after each molt. After passing some twenty days as caterpillars, and molting about five times, they are full grown and ready to spin themselves up into their cocoons; a very large proportion of them, however, fall victims, before they reach this stage, to the ants, wasps, and other foes which are always on the look-out for them. When the caterpillars leave off feeding, preparatory to spinning, they are sometimes as much as five inches in length by an inch in diameter, but they contract considerably before actually commencing their cocoons. The cocoon is spun in the usual manner and is so closely enveloped in the leaves of the food plant that, when it is torn away, permanent impressions, showing the shape and neurulation of the leaves, are left upon the silk. The cocoon is generally drab colored, and from two to three inches long, by an inch in diameter; it is irregular in shape, with thin firm walls, which are scarcely at all silky in appearance, except at the upper extremity where there is a natural orifice for the exit of the moth. This orifice is formed, as in the cocoons of other Saturniidae, by the convergence of a great number of silken fibres, which are left ungummed and are therefore soft and flossy, opposing an almost impenetrable hedge to any animal which tries to force its way into the cocoon, but opening readily when pushed aside by the moth which emerges from within. The moth thus effects its escape with hardly any perceptible disarrangement of the fibres, which close together again behind it. The stiff gummed parchment-like wall of the cocoon passes upon one side of the orifice, so as to form a cord, which is firmly wrapped around the twig from which the cocoon hangs, thus securing it from mishap in case the leaves, in which it is wrapped, become detached. The cocoon contains a large amount of thick strong silk which cannot indeed be reeled easily enough to make it worth doing, but which would have a considerable market value for carding and spinning purposes, if large quantities could be obtained; it is said that some of these cocoons have been collected in Burma and exported to England for this purpose, while attempts have also been made to domesticate the insect in China; but upon the whole experts seem to be agreed

that there is no chance of the *Atlas* silk competing successfully with that of such species as the *tusser*, which can be obtained so much more easily. Connected with *Attacus atlas*, besides *Attacus edwardsii*, which is probably a distinct though closely allied species, we may notice *Attacus silhetica* of Helfer (Journ. A. S. B. VI, p. 41, 1837) and *Attacus taprobanis* of Moore, Lep. Ceyl. II, p. 124, 1882), both of which forms, so far as the descriptions and figures of them go, seem indistinguishable from *Attacus atlas*.

ATTACUS EDWARDSII, White. Plate 2, fig. 2.

A large species, somewhat darker in color and with somewhat larger and differently arranged white markings, but very similar, both in general appearance and in size to *Attacus atlas*, of which it is little more than a constant variety. It is found in the hills in many parts of India (Sikkim, Shillong, Khasi Hills, Mussoorie, Western Ghats, and Mysore), but is usually scarce. In Sikkim, according to the late Mr. Otto Möller, it is found at an altitude of from 6,000 to 7,000 feet and goes through but one generation in the year, hibernating as a pupa inside the cocoon, from which it emerges as a moth during the rains (July to September). The cocoon is much like that of *Attacus atlas*, but is somewhat denser in structure and sufficiently different in shape to be distinguishable. The caterpillar is very like that of *Attacus atlas*, but differs from it markedly in possessing a number of black speckles on the two anterior pairs of fleshy protuberances. The specimen from which the drawing of the larva has been made was obtained by Mr. A. V. Knyvett at Kurseong. Mr. Knyvet describes the caterpillar as follows:—"General color, green-powdered above, especially on the tentacles, with a white powder which comes off in flakes, tentacles about half an inch in length, occurring in pairs on the third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, and eleventh segments, the twelfth segment being furnished with a single medium tentacle: the tentacles on the third and fourth segment are bluish, dotted with black, those on the other segments are green at the base, bluish at the apex, and covered with flakes of white powder; stigmata, light greenish blue in color; anal claspers with a large vermilion spot."

ATTACUS CYNTHIA, Drury. Plate 3.

This species is very closely allied to the *eri* silk moth (*Attacus ricini*) and is probably the original wild form from which the *eri* has been derived by domestication. It can, however, be easily distinguished from the *eri*, by its larger size and brighter and more golden coloration, and as the two forms appear to have somewhat different habits, it seems best to look upon them as belonging to distinct species.

Attacus cynthia is said to range over India, China, and some of the Malay Islands; in the Indian Museum are specimens from Mussoorie,

Sikkim, Shillong, Buxa, and Sibsagar, besides a single specimen from the Andaman Islands of what seems to be a local variety.

It is said to be common up to 5,000 feet in Sikkim, where, it is thought to be trivoltine, feeding upon *Zanthoxylum acanthopodium*, or *Z. alatum* (Möller). Its larval stages do not appear to have been observed in India. The cocoons, though much smaller in size, are very similar in structure, coloration, and general appearance to the cocoons of *Attacus atlas*; they are smaller and more compact than cocoons of *A. ricini*, but appear nevertheless to contain a considerable amount of silk, which would no doubt be valuable for carding purposes if it could be obtained in any considerable quantities. Of late they have appeared in the Calcutta market, where they are known as *Junglies*. Mr. G. C. Hodson writes that they are brought to market by Mahomedans, while the *eri* and *muga* trade is entirely in the hands of Marwarries. According to Captain Hutton the insect is also identical with a semi-domesticated species which is reared on a small scale in some parts of China, upon *Ailanthus glandulosa*, for the production of silk, and which has also been raised experimentally upon the same plant in Europe.

The forms *Attacus guerini* (Moore), *Attacus obscurus* (Butler), *Attacus canningii* (Hutton), and *Saturnia iole* (Westwood), have at different times been described as distinct species. From the descriptions and figures that have been given of them, however, they appear to be so nearly related to *A. cynthia* and *A. ricini* that until cause is shown for their separation it seems best to look upon them as synonyms of one or other of these two species. Of the species *Attacus vesta* (Walker) no description has been found, and it may, therefore, be neglected.

The moths, figured on plate 3, were determined by Mr. H. J. Elwes; the cocoon was one furnished by Mr. Otto Möller.

ACTIAS SELENE, Hübner. Plate 4.

This species is common in collections from all parts of India, and is said to occur in Ceylon and China. In the Indian Museum are specimens from Simla, Shillong, Khasi Hills, Sylhet, Sibsagar, Manbhum, Gobindpur, Lakhimpur, and from the neighborhood of Calcutta. In Sikkim, according to Möller, it is fairly common at an elevation of from 3,000 to 5,000 feet. It passes the winter as a pupa inside the cocoon, and goes through two generations in the summer, the first set of moths appearing in early spring and the second in July and August. The food plant of the caterpillar is *Zanthoxylum acanthopodium* or *Z. alatum*. In the hills around Mussoorie it was found by Hutton to feed on the wild cherry, wild pear, walnut, *Cedrela paniculata*, *Coriaria nepalensis* (Munsoory) and several other forest trees. The cocoon is coarse in texture, yields but little silk, and, as it is not forthcoming in any considerable quantities, it has no commercial value.

The following account of the rearing of the caterpillar in Mussoorie is taken from Captain Hutton's writings as given in Moore's Catalogue of Lepidoptera in the East India Museum :—

“ Moths, found in *coitu* in the middle of April, each laid, in the course of a few days, about 300 eggs which are about the size of mustard seed. After depositing their eggs the moths rapidly died off and the eggs began to hatch about the end of the month. The larvæ when first hatched are about a quarter of an inch in length, hairy, and of a pale rufous red with a single black band across the middle of the body, and a small black transverse mark on the anterior segment; along the back are two rows of small tubercles and another along each side, from each of which spring a few short hairs, the base of which forms a small black dot. There is also an anal tubercle, larger than the others, and placed between the two last tubercles of the dorsal rows; the head is black. . . . The first molt commenced when six days old, and this occupied three days, so that at the end of nine days the larva appeared in its second stage. The black transverse band upon the body had disappeared, but the head still remained of that color, and the rest of the body was hairy and rufous, the tubercles being black on the summit and more prominent; pro-legs brown. The period between each change was about ten days in some specimens, but varied in others between that and shorter periods, . . . In the third stage the caterpillar appeared of a bright rufous color, the black dots, or tubercles, being larger and more prominent, but there were no black bands. In the fourth stage the change was still more remarkable, for the caterpillar now appeared of a beautiful apple green, each tubercle headed with bright orange, except the four which spring from the second and third segments, which are ringed with black and crowned with pale yellow; and the anal and two posterior tubercles, which are green throughout. From each tubercle springs a small tuft of hair, the centre one of each being longer than the others; the head and pro-legs brown. Along each side is a line, which is red above and yellow below, and the spiracles are red; there is a line of very small yellow dots along each side between the rows of tubercles. In the fifth stage the colors are the same as they are in the fourth, also in the sixth and seventh stages; but the caterpillar increases rapidly in size, and is most beautiful and delicate in appearance, with a semi-transparency of hue which makes it look something like waxwork. One of these commenced spinning its cocoon on the 17th of July, being then about forty-six or forty-seven days old, and the remainder after the interval of a day or two; that is, on the 19th, 20th, and 25th July. The cocoon is formed of coarse brown silken threads, closely interwoven and of an ovate form. It is inclosed among the leaves of the tree, which are, in fact, glued closely round it. It is hard and not furnished interiorly with a soft silken bed, the chrysalis lying within a hard and hollow chamber. The chrysalis remained thus until the 14th August, when the one which had turned on the 17th July produced a perfect female after a period of twenty-nine days. Another, which had turned on the 19th July, came forth a male on the 16th August, showing the time to be pretty uniform. A large caterpillar, however, found in the forest on the 16th July, turned to a chrysalis on the 24th of that month; but, instead of coming forth in the autumn, it remained in the chrysalis state throughout the winter, as did some others, coming out in the following summer, namely on the 11th, 14th, and 18th of June.”

Hutton also describes the manner in which the moth works its way out of the cocoon by the aid of its wing spurs, which seem to have a cutting edge and to be used to sever the silk strands of the cocoon.

The moths from which the figures were made were determined by Mr. H. J. Elves; the cocoon was furnished by the late Mr. Otto Möller.

ACTIAS LETO, Doubleday. *Plate 5.*

This is a large insect allied to *Actias selene*; it is found at low elevations in the Himalayas and in Assam. According to Möller it is bivoltine, hibernating as a pupa inside its cocoon, the moths appearing in spring and autumn, its food plant in Sikkim being *Turpina pomifera*. In the Indian Museum, besides specimens of the moth from Sikkim, Buxa, and Sibsagar, there is a cocoon received from Sikkim as belonging to this species. It is much like cocoons of *A. selene* in structure and appearance, but is remarkable for a number of neat round holes, each about the sixteenth of an inch in diameter which penetrate the cocoon on all sides; these, however, may possibly have been caused by hymenopterous parasites.¹ Little seems to be known about the species, which is far too rare to have any value as a silk producer. It is chiefly remarkable for the great difference in the shape and coloration of the two sexes, which are so dissimilar in appearance that they were for many years thought to be distinct species, and in most works on Entomology are described—the male as *A. leto*, the female as *A. mænas*. Connected with *Actias leto* is a form which is found in the Andaman Islands and which has been described by Moore under the name of *Actias ignescens* (P Z. S. 1877, p. 602). There are no representatives of it in the Indian Museum, but from the description it appears to be little more than a local variety of *A. leto*.

The moths from which the figures were made were determined by Mr. H. J. Elwes; the cocoon was furnished by the late Mr. Otto Möller.

ANTHERÆA FRITHII, Moore. *Plate 6.*

In the Indian Museum are specimens of this species from Sikkim, Sibsagar, and Buxa. According to Möller it is a bivoltine species, common at low elevations in Sikkim, where it feeds upon sâl (*Shorea robusta*), hibernating as a pupa, and the moths appearing in March and August, respectively. Rondot (*L'Art de la Soie* II, p. 117, 1887) writes that according to Fallon, who reared it in France, the larva is of an ochre yellow, ringed with black. The cocoons are yellowish white in color and very similar to those of *A. roylei*, but less silky on the exterior. According to Rondot they contain a considerable amount of silk. The above seems to be all that is known of *Antheræa frithii*, which is too scarce to be likely to be of any use as a silk producer.

The specimens from which the figures were made were reared in the Indian Museum from cocoons furnished by the late Mr. Otto Möller.

¹ Since the above was written information has been received from Mr. A. V. Knyvett, who has observed this species in Sikkim, and has found the holes invariably present in the cocoons.

ANTHERÆA HELFERI, Moore. Plate 7, fig. 1.

In the Indian Museum are several moths of both sexes of this species from Sikkim, but there are no authentic cocoons, and little seems to be known about it beyond the bare fact of its occurrence in Sikkim, and Hutton's observation (Journ. Agri. Hort. Soc. Ind. III., p. 125, 1871) that the cocoon resembles that of the Tusser (*Antheræa mylitta*). The insect is far too scarce to have any commercial value whatever. The moth from which the figure of the male was made was determined by Mr. H. J. Elwes. The figure of the female is taken from a specimen in Colonel A. M. Lang's collection determined by Mr. F. Moore.

ANTHERÆA ROYLEI, Moore. Plate 9.

In the Indian Museum are specimens of this species from Simla, Mussoorie, Sikkim, and the Khasi Hills, also a cocoon from Sikkim. It is said to be very closely allied to *Antheræa pernyi*, a semi-domesticated species largely reared upon oaks in China for the production of silk. Rondot, indeed, in his *L'Art de la Soie*, Vol. II, notices that a hybrid race has been obtained by crossing *A. pernyi* males with *A. roylei* females. If, therefore, Hutton is right in saying that *A. roylei* can be easily reared upon the common hill oak (*Quercus dilatata*?), it is not by any means impossible but that it may become of value for the production of silk in the Himalayas, the cocoons being of a kind which would certainly be valuable for carding, if not for reeling purposes. Little has hitherto been recorded about this insect, though it has been bred by several people both in India and in Europe (see Entomologist, XIV, p. 246, and Bull. Soc. Ent. France (5), IV, p. 154). Hutton writes in the Journ. Agri. Hort. Soc. Ind. III, p. 125, 1871: "*Antheræa roylei* is common at Simla, Mussoorie, Almora, and I think Darjiling. It feeds upon the common hill oak, spinning a large but thin cocoon between three or four leaves The outer coating is very strong, and I do not think it could be reeled, but within this case is the true cocoon, of an oval form and yielding good silk. The worms are easily reared and sometimes give two or three crops, but this is when treated in the house." Major Harford also, writing recently from the North-West Himalayas, notices the peculiar double-walled cocoons which he has found upon *ilex* (hill oak?) and the khakee colored males and pinkish females he has bred from them. Some observations also on the habits of *A. roylei*, by the late Mr. Otto Möller, appeared on page 201 of Vol. I of these *Notes*; it is thought, however, that these observations referred to some other species, as the cocoon forwarded with them was single-walled and pedunculate, instead of having the double-walled structure characteristic of typical *A. roylei* cocoons. A double-walled cocoon found by Mr. A. V. Knyvett on a chestnut tree in Sikkim was sent to

the Indian Museum in May 1890, and produced, in the early part of the rains, a female moth of the typical pinkish color, and Mr. Knyvett also writes that he has found *A. roylei* cocoons on *Mohwa* trees, oak, and birch in Sikkim. The above is all that we at present know about *A. roylei* proper. The figures of the caterpillar and cocoon are taken from specimens obtained by Mr. A. V. Knyvett in Sikkim; those of the moths from Hutton's type specimens which are in the Indian Museum collection. Closely connected with *A. roylei* proper is an insect with a firm singled-walled pedunculate cocoon which has been found by Mr. A. V. Knyvett upon wild cherry trees in Sikkim. The cocoons of this form, which have been sent to the Indian Museum, are much like the cocoons of *Antheraea frithii*, but moths reared from them by Mr. Knyvett are almost indistinguishable from moths reared from the typical double-walled cocoons of *A. roylei*, the chief distinction consisting in the greater pinkness of those reared from the pedunculate cocoons. As, however, the females reared from double-walled cocoons show every variety of color from pink to greenish brown, and are in some cases altogether indistinguishable from females reared from pedunculate cocoons, it would seem most probable that the difference in the structure of the cocoon is to be attributed more to the difference in the food plant than to any specific distinctness in the insects. The differences observed by Mr. Knyvett between the caterpillars of the two forms, though very remarkable, not being of a sufficiently radical nature to warrant their separation under distinct specific names.

OAK SILK WORMS OF CHINA AND JAPAN. *Plate 7, fig. 2, and plate 8.*

An account of *Antheraea roylei*, which is the oak-feeding silk worm of the Himalayas, would be incomplete without a notice of the very closely allied oak-feeding silk worms of China and Japan. These are *Antheraea pernyi* (Guérin Méneville, Rev. et Mag. de Zool. 1855, p. 297, pl. 6, fig. 1), which is reared in a semi-domesticated state over large areas in Northern China, for the production of silk, and *Antheraea yamamai*, which is the corresponding form in Japan. About twenty-five years ago, when mulberry silk raising in Europe was threatened with extinction, these species attracted a good deal of attention, and were introduced¹ and partially acclimatized in France by experimentors, who hoped to furnish a substitute for the mulberry-feeding species. The revival of the mulberry silk industry, however, with the adoption of Pasteur's treatment for the silk worm disease, has thrown the oak-feeding species again into the

¹ As told by Van Westmaas (Tijd Voor. Ent. VII, 1864), the story of the obtaining of the eggs of *A. yamamai*, through a young Japanese, who in 1862 risked his life to get them for M. Pompe van Meerdervoort in Japan, recalls the difficulties encountered in the middle ages by the monks who first introduced the eggs of the mulberry-feeding species into Europe from China.

shade, so that the experiments, which at one time seemed distinctly promising, have not led to any practical results. That *A. pernyi* and *A. yamamai* are at least very closely allied to *A. roylei* is shown not only by the great superficial resemblance of the three forms (*vide* plates 7 and 8), but also from the fact that hybrids have been raised in Europe both between *A. pernyi* and *A. yamamai* (Berce and Goossens: Bull. Soc. Ent. France (5), IV, p. 154), and also between *A. roylei* and *A. pernyi* (Wailly: Ent. XLV, p. 246). An excellent account of *A. pernyi* in China is given by Rondot (*L'Art de la Soie*, II, 1887, p. 127). The following is an abstract:—

Antheræa pernyi is a bivoltine species found both wild and also in a semi-domesticated state upon oak trees in many parts of China, where it is reared extensively for the production of silk. The amount of fresh cocoons annually reared has been estimated at twenty-two millions of kilogrammes, of which a considerable amount is imported into Europe. Two yields of silk are obtained in the year, one in the spring and another in the autumn; the spring rearing occupying about sixty days and the autumn rearing about a hundred. The insect is generally reared indoors, but to a certain extent also upon trees or bushes in the open air. The worm is also common in a wild state in the forests and copses of oak trees on the mountain sides. In Koïeitchou (according to Father Perny) there is an annual variety of the worm which is less esteemed than the bivoltine one, a fact which is noticeable in connection with the tendency to become annual, which has been observed in the species when reared in France. The cocoon is enveloped in two or three oak leaves drawn together by a network of silken strands, and is further attached at one end to some small branch or leafstalk by a flat silken cord. The cocoon of the spring rearing contains only about half as much silk as that of the autumn rearing, but the silk itself is far more brilliant, that of the autumn rearing being somewhat dull and lustreless. The cocoons are either reeled or spun. The reeling is done in two ways—either wet or dry. In the dry process the cocoons, after having been dipped in a mordant made from oakwood ashes, are washed in clean water and are then reeled dry, the basket containing them, however, being sometimes steamed over a vessel of boiling water. In the wet process, the cocoons are simply reeled as they lie in the iron boiler, which contains either a solution of raw soda or strong mordant made out of oak ashes, the liquid being but just sufficient to cover the cocoons; the wet process therefore differs materially from that of mulberry silk filatures, where deep basins of water are used for holding the cocoons while they are in process of reeling. Of the wet and dry processes, the dry one is preferred and gives the most satisfactory results. A large portion of the autumn crop and all the pierced cocoons are spun, the spinning being done either by hand or with a jenny worked by the foot.

The figures of *A. roylei* are from specimens in the Indian Museum; those of *A. yamamai* after Snellen's figures (*Tijd Voor. Ent.* VII, 1864); those of *A. pernyi* after Guérin Méneville's figures (*Rev. et Mag. de Zool.*, 1855).

OTHER INDIAN SPECIES OF ANTHERÆA.

Besides the cultivated species—*Antheræa mylitta* (Tusser), *A. assama* (Muga)—described in Vol. 1, No. 3 of these *Notes*, and the wild species—*Antheræa roylei*, *A. helferi*, and *A. frithii*, which have been noticed above, five other Indian species of the genus *Antheræa* have been described by entomologists. There are no specimens of them, how-

ever, in the Indian Museum collection, and it seems very doubtful to what extent they are entitled to be looked upon as distinct. They are as follows :—(1) *Antheræa cingalesa* of Moore from Ceylon : Moore's figure of the moth, in his *Lepidoptera of Ceylon*, Vol. II, is very like some forms of *A. mylitta*, but his figure of the larva presents certain peculiarities ; (2) *Antheræa andamana* of Moore, from the Andaman Islands : no figure seems to have been published of this insect, and as no comparison is drawn, in the description, between it and other *Antheræas*, it is impossible to judge to what extent it is distinct ; (3) *Antheræa perrottetii* of Guérin Méneville from Pondicherry. This insect, according to Walker (*B. M. Cat. Lep. VI*, p. 1379), is very nearly allied to *A. assama*, and Guérin Méneville's description of the cocoon (*Mag. de Zool. VI*, pl. 123, 1844) also answers to that of *A. assama*, so it is not improbable that it may be a variety of that species, though Guérin Méneville's figure of the moth presents some peculiarities. According to Rondot (*L'Art de la Soie*, II, p. 117) it feeds upon *Eugenia jambolana*, *Zizyphus* sp. and other trees ; (4) *Antheræa simplicia* of Massen and Weymer, from the "East Indies." The writer has not had an opportunity of comparing the description of this species, so its precise habitat and identity remain to be ascertained ; (5) *Antheræa fraterna* of Moore (*P. Z. S.* 1888, p. 402) from Kussowlee and Kangra : this species also is unknown to the writer.

CRICULA TRIFENESTRATA, Herr Schöff. *Plate 10, fig. 1.*

This variable species is said to be common in all parts of tropical India, and especially in Burma, Assam, and Chota Nagpore. The Indian Museum possesses specimens from Sikkim, Sibsagar, Cachar, Dacca, the Andaman Islands, and Java. The larvæ are usually found upon mango trees, but also feed upon a number of other trees ; they are gregarious in their habits and spin large agglutinated masses of gorgeous reticulated cocoons, which are of the color and brilliancy of molten gold when fresh. They are thought by some silk experts to be likely to prove valuable for carding purposes, though Stack in his account of Silk in Assam (1884) reports that the silk is almost worthless. He writes : "The cocoons are of a thin and open texture, yielding very little silk, which cannot be reeled. The worm is covered with hairs, which produce irritation of the skin, and for this reason it is regarded as unclean by the Hindus, but Kacharis, Rabhas, and Meches occasionally mix the silk with *eri*, where it reveals its presence by the itching it causes. This irritating property of the worm is said to protect it against crows and bats."¹

¹ Mr. G. C. Hodgson writes :—"The *Cricula trifenestrata* found in Ranchi would be a valuable silk for carding purposes, but so far we have never been able to get it in a form fit for export. The chrysalids are usually alive when brought to Calcutta, whilst for commercial purposes they must be thoroughly desiccated before being screwed into bales."

The insect is said to go through a series of generations in the year, each generation taking about two months to complete, and the rains broods being the strongest and producing most silk.

The moths from which the figures were made were determined by Mr. H. J. Elwes.

CRICULA DREPANOIDES, Moore. *Plate 10, fig. 2.*

This insect differs very markedly from *C. trifenestrata* in general coloration; it is recorded as occurring in Sikkim, from which locality also the Indian Museum possesses specimens. Nothing seems to be known on the subject of its habits. It is presumably very rare.

The moth from which the figure was taken was determined by Mr. H. J. Elwes.

RHODIA NEWARA, Moore. *Plate 11.*

This fine species is common in Sikkim, where it spins a brilliant green cocoon, with slit-like opening at the upper extremity, through which the moth makes its escape, and drain-like passage at the bottom, which is supposed to serve for the escape of any water which may happen to enter the cocoon during the rainy season owing to the imperfect closing of the upper slit. According to Möller the insect is found at an elevation of from 4,000 to 7,000 feet in Sikkim, and goes through but one generation in the year; it hibernates in the egg; the larvæ emerge early in the spring, and finish spinning their cocoons by the end of May; the moth appears during the first half of November at 5,000 feet, and somewhat earlier at higher elevations; the larvæ feed upon the weeping willow and wild walnut.

The specimen from which the figure of the moth was taken has been determined by Mr. H. J. Elwes; the cocoon was furnished by the late Mr. Otto Möller.

SATURNIA STOLICZKANA Felder. *Plate 13, fig. 4.*

This species was figured by Felder (Reise Novara, Lep., pl. 87, fig. 3, 1864—75) from Ladak. Nothing seems to have been recorded about it, but in the Indian Museum are some broken wings from an elevation of 10,500 feet in Lahoul, and also a specimen from Kulu, which answer to the figure.

SATURNIA CIDOSA Moore.

S. cidosa (Moore, Trans. Ent. Soc. Lond.(3), ii, p. 423, pl. 22, fig. 2, 1864—66) is represented in the Museum collections by a single moth from Sikkim. According to Hutton (Journ. Agri. Hort. Soc. Ind., iii, 1871, p. 125) it is closely allied to *S. pyretorum*.

SATURNIA PYRETORUM, Westwood.

This species was originally described by Westwood (Cab. Or. Ent., p. 49, pl. 24, fig. 2, 1848) from China, and was noticed by Hutton (Journ. Agri. Hort. Soc. India, III, p. 125, 1871) as occurring in Sikkim and Cachar; there seems, however, to be some doubt as to whether it extends into India. In China, according to the *resumé* given by Rondot (*L'Art de la Soie*, II, 1887, p. 205), the caterpillar is of medium size, longitudinally streaked with bright turquoise blue, alternating with canary yellow, and covered with bristling yellow hairs; it feeds chiefly upon the *Liquidambar formosana* and *camphor* trees. The cocoon is ovoid, much produced in length, pointed, open at one end, and surrounded with floss, which is deep brown in color. The silk is silver grey or brownish grey in color, coarse and very tough; it is said to be used on a considerable scale commercially, the silk glands of the worm being also used for the preparation of gut for fishing lines.

OTHER SATURNIAS.

Saturnia grotei (Plate 13, fig. 2), *Saturnia lindia*, *Saturnia anna*, and *Saturnia hockingii* are so closely allied to each other that it seems most convenient to consider them together, as very little is known about any of them. *Saturnia grotei* (Moore P. Z. S. 1859, p. 265, pl. 65, fig. 2, and Butler, Ill, Typ. Lep. Het. B. M. V, p. 61, pl. 94, figs. 3 and 4) is represented in the Museum collections by specimens from Kulu and Sikkim; *Saturnia lindia* (Moore, Tr. E. Soc. (3), ii, p. 424, pl. 22, fig. 3, 1864—66) by specimens from the N.-W. Himalayas; *Saturnia anna* (Moore, P. Z. S. 1865, p. 818) by specimens from Sikkim; while *Saturnia hockingii* (Moore, P. Z. S. 1865, p. 818 and Butler, Ill, Typ. Lep. Het. B. M. VII, p. 39, pl. 124, figs. 2 and 3), described from Kulu, is not represented in the Museum Collection. It should be noticed for the fact that Moore records that the cocoon, which is formed "under stones," is "pyriform, dark brown, hard, pointed, and lax at the upper end." The specimen from which the figure of *S. grotei* was taken has been identified by Mr. H. J. Elwes.

LOEPA KATINKA, Westw.

Four species of the genus *Loepa* have been described from India, viz. *Loepa katinka* (Westw., Cab. Or. Ent., p. 25, pl. 12, fig. 2, 1848), found in Sikkim, at an elevation of from 5,000 to 7,000 feet, and also in Assam; *L. miranda* (Moore, Trans. Ent. Soc., Lond. (3), ii, p. 424, 1864—66) from Sikkim; *L. sikkima* (Moore, P. Z. S., 1865, p. 818) from the hot valleys in Sikkim; *L. sivalica* (Hutton, Journ. A. H. Soc. Ind., III, 1871, p. 125, and Moore, Wardle's Wild Silk, 1881, p. 7) from Mussoorie. In the Indian Museum are specimens, determined by Mr.

Moore as belonging to the three forms—*katinka*, *miranda*, and *sikkima*, together with intermediate varieties; so, taking into consideration the fact that the three forms are found within a few miles of each other in Sikkim, it seems very doubtful whether they are really distinct. With regard to the fourth form,—*L. sivalica*,—found by Hutton in Mussoorie at an elevation of 5,500 feet, Hutton notes that it is closely allied to *L. katinka*, while Moore writes that it spins a long cocoon, pointed at each end, and of a dark greenish grey color. The above, with Atkinson's note (P. Z. S. 1865, p. 818) to the effect that moths of the *L. sikkima* form appear in the beginning of August, while *L. katinka* appears later, concludes what has been recorded on the subject of this genus in India.¹

The specimen of *L. miranda* from which the figure has been taken is in Colonel A. M. Lang's collection; it was identified by Mr. F. Moore.

NEORIS HUTTONI, Moore. *Plate 13, fig. 3.*

In the Indian Museum are a male and female of this species from Mussoorie. Hutton notices that he found the larvæ at 6,500 feet elevation in Mussoorie in April feeding on the wild pear tree, the cocoon being an open network worthless for silk production (Journ. Agri. Hort. Soc. Ind. III, 1871, p. 125). A second species of this genus has been described by Moore (P. Z. S., 1872, p. 577) under the name of *Neoris shadulla*, from the neighbourhood of Yarkand; there are no specimens of it in the Indian Museum.

The figures of *N. huttoni* are from Captain Hutton's specimens.

SALASSA LOLA, Westw. *Plate 12, fig. 1.*

This fine species was described by Westwood (Cab. Or. Ent., p. 25, pl. 12, fig. 3, 1848) from Sylhet, and the Indian Museum possesses specimens of it from Sikkim. With regard to its habits, Mr. A. V. Knyvett has observed in Sikkim that the caterpillar, previous to transforming into a chrysalis, spins a few leaves and chips together into a sort of rough covering in the ground exactly as is done by the species *Salassa (Saturnia) royi*.

The specimen from which the figures of the moths were taken was determined by Mr. H. J. Elwes; the caterpillar was drawn from a specimen furnished by Mr. A. V. Knyvett.

SALASSA ROYI, Elwes. *Plate 12, fig. 2.*

This species was described by Elwes (P. Z. S., 1887, p. 447, and Trans. Ent. Soc., Lond., 1888, pl. 8, fig. 2) from a male taken at an

¹ Since the above was written the following note has been received from Mr. A. V. Knyvett, who has observed this genus in Sikkim: "The high elevation form *L. katinka* is quite distinct from the hot valley form, which may be either *L. miranda* or *L. sikkima*."

elevation of 10,000 feet in Sikkim. It was originally referred to the genus *Saturnia*, but the observations of Mr. A. V. Knyvett indicate pretty clearly that it should rather be included in the genus *Salassa*. According to Mr. Knyvett, the caterpillars are very like those of *Salassa lola*, only bigger; the chrysalis also is formed in the ground in a little, loose silk, much as is the case with *Salassa lola*.

The male was figured from specimens determined by Mr. H. J. Elwes, the female from a specimen deposited for a short time in the Indian Museum by the late Mr. Otto Möller.

CALIGULA SIMLA, Westw. *Plate 14, fig. 1.*

In the Indian Museum are specimens of this species from Simla, Mussoorie, Sikkim, and Khasi Hills, besides cocoons which are supposed to belong to it and which were obtained in Dehra Dun, probably from the Mussoorie Hills. Hutton writes (*Journ. Agri. Hort. Soc. Ind.*, iii, 1871, p. 125) that the larva feeds on walnut, *Salix babylonica*, and wild pear, the cocoon being a coarse open network, through which the pupa is visible, and yielding no silk.

CALIGULA THIBETA, Westw. *Plate 14, fig. 2.*

In the Indian Museum is a male of this species obtained from Sikkim. According to Hutton (*Journ. Agri. Hort. Soc., Ind.*, III, 1871, p. 125) the original specimen from which the species was described came from Kumaon, and he also found it in Mussoorie on *Pieris ovalifolia*. It seems to be a well marked species, quite distinct from *C. simla*. A third species of the genus *Caligula*, viz. *C. cachara*, was described by Moore (*P. Z. S.* 1872, p. 578) from Cachar; there are no specimens of it in the Indian Museum. Butler (*Ill. Typ. Lep. Het. B. M. V.*, p. 61, pl. 94, fig. 2, 1881) describes a species from Sikkim, under the name of *Rinaca extensa*. From the figure this insect would seem to be indistinguishable from *C. thibeta*.

The figure of *C. thibeta* is from a specimen determined by Mr. H. J. Elwes.

RINACA ZULEIKA, Hope. *Plate 14, fig. 3* (*Trans. Linn. Soc., Lond.*, XIX, p. 132, pl. 11, fig. 5, 1845).

This species has been recorded from Sylhet, Sikkim, and Simla; the Indian Museum possesses moths from Sikkim, also a single chrysalis case, but no cocoon. Rondot (*L'Art de la Soie*, II, 1887, p. 205) writes that the cocoon is reticulated and without economic value. According to Möller, the caterpillars feed in Sikkim upon the plants *Actinodaphne sikkimensis* and *Acer caudatum vel campbellii*. According to Mr. A. V. Knyvett, the caterpillar is to be found at an elevation of about 7,000

feet in Sikkim through October and November. It spins a rough open cocoon on the ground at the foot of the food plant, the moth emerging in the following August.

The figure is from a specimen determined by Mr. H. J. Elwes.

BRAHMĒA CERTHIA, Fabr. *Plate 15, fig. 1* (Ent. Syst. iii, I, p. 412, 1793).

This species is represented in the Museum Collection by specimens from Sikkim and Shillong. Nothing seems to have been recorded of its habits or development. Three closely allied forms—*B. whitei* Butler, from North-West India, *B. conchifera*, Butler, from Sylhet and Darjiling, *B. wallichii*, Gray, from Assam and Nepal—have been figured by Butler (Ill. Typ. Lep. Het. B. M. V, pl. 95, figs. 1, 2, 3, 4, 5, and 6). They appear to be so closely related to *B. certhia* as to be scarcely distinguishable from it. A fourth form—*B. rufescens*—Butler, from North-East Bengal, has been described (Ann. Mag. N. H. 5, VI, p. 62, 1880) as related to, and in some respects intermediate between, the others. It seems most convenient to await further observation on the habits and life histories of these insects before endeavouring to separate them into distinct species.

The figure of *B. certhia* is from a specimen determined by Mr. H. J. Elwes.

THEOPHILA HUTTONI, Westw. *Plate 15, fig. 3.*

This is a bivoltine species, which is common upon wild mulberry trees on the lower slopes of the North-West Himalayas. The caterpillars of the first generation, according to Hutton (Trans. Ent. Soc., Lond., 3, ii, 1864—66; and Journ. Agri. Hort. Soc., Ind., III, 1871), appear about April, and the cocoons are formed in May and September respectively. The insect hibernates in the form of eggs glued on to the bark of its food plant. The cocoon is whitish in color and of soft loose consistence, not unlike the cocoons of some Bengal *Bombyx* silk worms, but much less compact; it is formed between the leaves of the food plant. The silk is of excellent quality, and, according to Cope (Rondot, *L'Art de la Soie*, II p. 6), can be reeled; so, if it could be obtained in any considerable quantities, there is little doubt but that it would be of value. Hutton's attempt, however, to cultivate it for commercial purposes proved unsuccessful, as the worms were too restless to submit to domestication in the house, and when left at liberty upon the trees were so much attacked by birds and predaceous insects as to render the yield of silk unprofitable. It is possible that the restlessness exhibited by the worms, when under cover, may have been due to want of the moisture to which they are ordinarily exposed on the hill slopes; this having proved to be the case with tusser

(*Antheræa mylitta*) whose larvæ can only be raised in captivity when they are frequently watered (see footnote to page 160 of the first volume of these *Notes*). Even if this should turn out to be the case, however, with *T. huttoni*, it would seem of doubtful utility to employ mulberry leaves for rearing it, when they might with no greater expenditure of labor be utilized for rearing one of the *Bombyx* varieties which are already domesticated and which produce a silk whose commercial value is undoubted.

The figure of the larva is copied from a colored drawing prepared by the Museum artist under the direction of Mr. Wood-Mason.

Connected with *Theophila huttoni* are several forms which are so closely allied to it as to make it very doubtful to what extent they can reasonably be looked upon as distinct. They are the following :—

(1) *Theophila religiosa* (= *Bombyx religiosa*, Helfer, Journ. As. Soc. Beng., Vol. VI, p. 41, 1837).—This insect feeds upon the Pipal tree (*Ficus religiosa*) in Assam. Helfer originally described it, without seeing the insect, from a figure which was sent to him, and Moore (Cat. Lep. Mus. E. I. C., p. 381, 1858) writes : “After examination of typical specimens of *B. huttoni*, and comparing them with the descriptions of Dr. Helfer’s *B. religiosa*, I am inclined to believe that they are one and the same species.” This form therefore may be neglected.

(2) *Theophila bengalensis* (Hutton, Trans. Ent. Soc. Lond. (3), ii, p. 322, pl. 19, fig. 5, 1864—66; and Journ. Agri. Hort. Soc. Ind. iii, 1871, p. 125).—This form feeds upon the *Artocarpus lacoocha* tree, in Lower Bengal, and has been also found at an elevation of 2,000 feet in Sikkim upon *Artocarpus chaplasha* (see page 200 of Vol. I of these *Notes*). The moth and cocoon closely resemble the typical *T. huttoni* from the North-West Himalayas, but the larvæ, as figured by Hutton, differ from *T. huttoni* larvæ both in being greyish white, instead of yellow mottled with brown, and in having somewhat smaller spines. If this difference should prove constant, *T. bengalensis*, feeding as it does upon a different plant and living in a different locality, might be considered to constitute a distinct species. For the present, however, it seems most convenient to look upon it as a variety only; and this view is supported by the fact that the form which has been described as *T. affinis* is to a certain extent intermediate between *T. huttoni* and *T. bengalensis*.

The figure of the larva (Plate 15, fig. 4) is copied from a colored drawing prepared by the Museum artist under the direction of Mr. Wood-Mason.

(3) *Theophila affinis*, plate 15, fig. 2 (Hutton, Journ. Agri. Hort. Soc. Ind. III, p. 125, 1871).—This form was described by Hutton as resembling *T. huttoni* in shape, coloration and marking, and differing from it only in its smaller size and in being polyvoltine. In Chota Nagpur the caterpillar feeds, like *T. bengalensis*, upon the *Artocarpus*

lacoocha tree, but Hutton succeeded in rearing it upon mulberry. In the Indian Museum are moths and cocoons of this form from Gobindpur; also a moth which is thought to be Hutton's type from Chota Nagpur; they are indistinguishable from moths of *T. bengalensis* from the neighbourhood of Calcutta. There is also a carefully colored drawing made by a Native artist in the Museum, of a full grown larva from Gobindpur, showing the yellow and brown markings and the prominent spines which are supposed to be characteristic of *T. huttoni*. *T. affinis*, therefore, may be looked upon as intermediate between *T. bengalensis* and *T. huttoni*, and is consequently a variety of the latter.

The figures of the moth and of the cocoon are from specimens in the Museum Collection; that of the larva is copied from a colored drawing made by the Museum artist under the direction of Mr. Wood-Mason; the cocoon is from a photograph taken by Mr. Wood-Mason.

(4) *Theophila sherwilli* (= *Bombyx sherwilli*, Moore, Trans. Ent. Soc. Lond. 3, II, p. 423, pl. XXII, fig. 1, 1864—66; also Hutton *loc. cit.*, p. 324).—This form was described from a moth said to have been obtained in the Eastern Himalayas; nothing, however, has been recorded of its habits or transformations. The original figure and description of the moth would answer completely to a large specimen of the variety *T. bengalensis*, with the exception of the black tip to the abdomen which *T. sherwilli* is represented as possessing. In the absence, therefore, of further information, this form may be looked upon as a somewhat exceptionally marked specimen of *T. huttoni*, var. *bengalensis*.

TRILOCHA VARIANS, Walker. Plate 15, fig. 5.

This small species is common all over India and Ceylon; it spins a minute but compact cocoon of yellowish silk between the leaves of the trees upon which it feeds. It is fairly common, but the cocoons are not found in any large quantities together, and are far too small to make it worth while to collect them individually. In Calcutta the moths are often attracted by lamps into houses in the cold weather and the larvæ have been reared in the Indian Museum upon the leaves of Bukool tree (*Mimusops elengi*). According to Hutton (Tr. E. S. III, 2, p. 331, 1864—6), Grote found it in February and March in Calcutta feeding on *Trophis aspera*, *Ficus indica*, and *Ficus religiosa*, while in Madras Elliot found it upon *Ficus religiosa*; and according to Moore (Lep. Ceyl. II, p. 136) Thwaites found it in Ceylon upon *Artocarpus integrifolia*. Nothing further seems to have been recorded of its life history, but from the fact of the moths and larvæ being found in the middle of the cold weather it would seem likely to be a polyvoltine.

The figures are from specimens reared in the Indian Museum.

TRILOCHA ALBICOLLIS, Walker.

Larvæ of this species were found by Forsayeth in August, feeding upon Pipul (*Ficus religiosa*) in Mhow, the moths emerging the same month (Trans. Ent. Soc. Lond. p. 408, 1884). Forsayeth's description and figures of the various stages of the insect agree very closely with the *T. varians* of Calcutta, and it would seem by no means improbable that the two forms are little more than varieties of each other. A third species—*Trilocha cervina*, was described by Walker (Brit. Mus. Cat. Lep. Het. xxxii, p. 489, 1865) from India; but no particulars are given beyond a bare description of the moth. The precise locality is unknown, and there are no specimens in the Indian Museum; so, the form must either be extremely rare or identical with one of the better known species.

OCINARA LIDA, Moore.

This species was originally described (Cat. Lep. Mus. E. I. C., p. 381, 1858) from Java, and an account of its habits was subsequently given (Trans. Ent. Soc. Lond. 3, II, p. 326, 1864—66) by Hutton, who named it in the first instance *O. moorei*, but afterwards recognized its identity with *O. lida* of Moore (Journ. Agri. Hort. Soc. Ind. III, p. 125, 1871). Hutton found it between 5,000 and 6,000 feet elevation in Mussoorie in the North-West Himalayas, where it feeds upon the leaves of *Ficus venosa*, and spins a small white oval cocoon. The cocoon is generally enveloped in a leaf, and covered with loose silk; it is to be found both in May and August, and Hutton supposed that at least two, and perhaps three or four, generations are gone through in the year. He considers the cocoon too small to be of any use. The larva is rough and resembles the bark so closely as to be very difficult to be distinguished from the latter upon the twigs to which it clings.

OCINARA LACTEA. *Plate 10, fig. 3* (Hutton, Trans. Ent. Soc. Lond. 3, II, p. 382, 1864—66).

This species was found by Hutton feeding with *O. lida* upon *Ficus venosa* in Mussoorie. The two forms are evidently closely allied and have very similar habits, but Hutton was of opinion that they are distinct, and as there are no satisfactory specimens of *O. lida* in the Indian Museum, it has not been possible to compare them. *O. lactea* is represented in the Museum collection by specimens from Sikkim and Kulu, as well as from Mussoorie; so, it is probable that the species extends throughout the Himalayas, though it is too rare and the cocoons are too small for it to have any value as a silk producer. The figure of the moth is from Captain Hutton's specimen in the Indian Museum; that of the larva is after Captain Hutton's figure in the Trans. Ent. Soc. Lond.

OCINARA COMMA (Hutton, Trans. Ent. Soc. Lond. 3, II, p. 330, 1864—66).

In the Indian Museum are moths which are thought to be Hutton's type specimens of this species from Dehra Dun (2,300 feet elevation in the North-West Himalayas), where, according to Hutton, they are found upon mango trees. They are very similar in appearance, and seem to be closely allied to *O. lactea*.

OCINARA DIAPHANA, Moore.

This species was described by Moore (Descr. Ind. Lep. Atk. I, p. 83, 1879) from the Khasia hills in Assam. Nothing seems to be known about it beyond Moore's note that the male moth differs from *O. lactea* of Hutton "in the absence of the black markings on the forewing and on the abdominal margin." These appear to be characters of very secondary importance, so it may reasonably be inferred that, like *O. comma* and *O. lida*, it is very closely related to *O. lactea*.

OTHER INDIAN BOMBYCIDÆ.

Aristhala sikkima (Moore, P. Z. S. 1879, p. 406, pl. 33. fig. 3) from Sikkim, *Aristhala thwaitesii* (Moore, Lep. Ceyl. II, p. 136, pl. 33, fig. 2, 1882 from Ceylon, and *Primosticta fenestrata*, Butler (Ill., Typ. Lep. Het. B. M. VI, p. 20, pl. 106, fig. 5, 1886) are usually included in the family of *Bombycidæ*; so, they are noticed here, though nothing is known of them beyond the bare descriptions and figures which have been published of the moths. There are no specimens of them in the Indian Museum, and it is even doubtful whether they spin cocoons; so, they may be neglected in considering the silk-producing species which are to be found in India.¹

¹ The species—*Hanisa subnotata* (Walker, Journ. Linn. Soc. Lond. III, p. 188, 1859; and Moore, P. Z. S., 1879, p. 406)—given erroneously in the Catalogue of the Moths of India as occurring both in Singapore and India, has only as yet been recorded from Singapore; so, it does not enter into the geographical area under consideration in this paper.



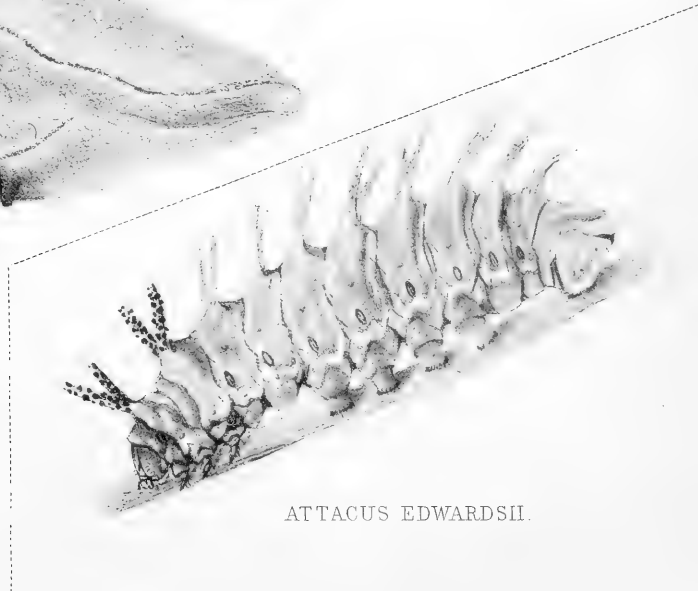


a

b

c

ATTACUS ATLAS.

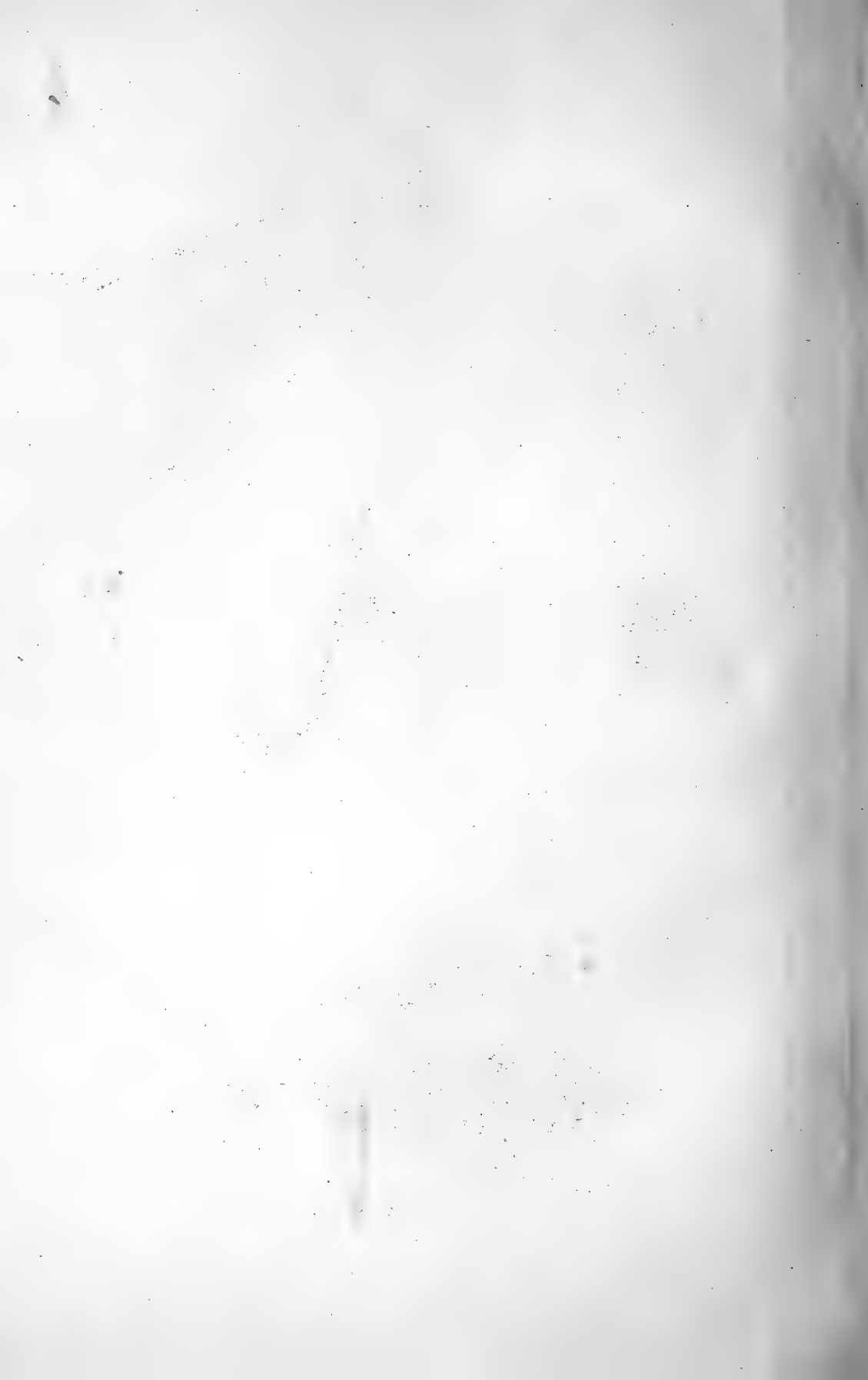


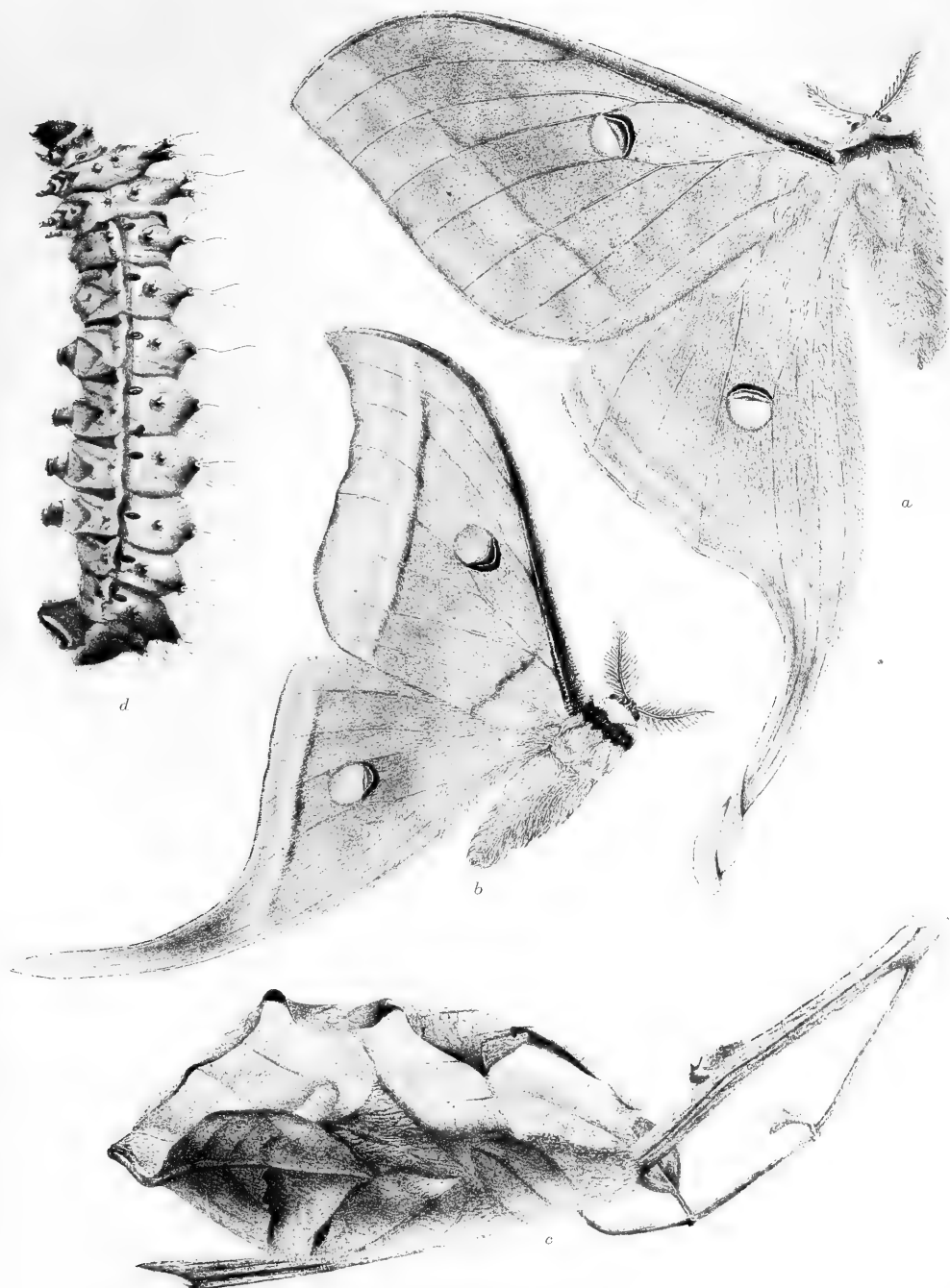
ATTACUS EDWARDSII.





ATTACUS CYNTHIA.





ACTIAS SELENE.



ACTIAS LETO.





a



c



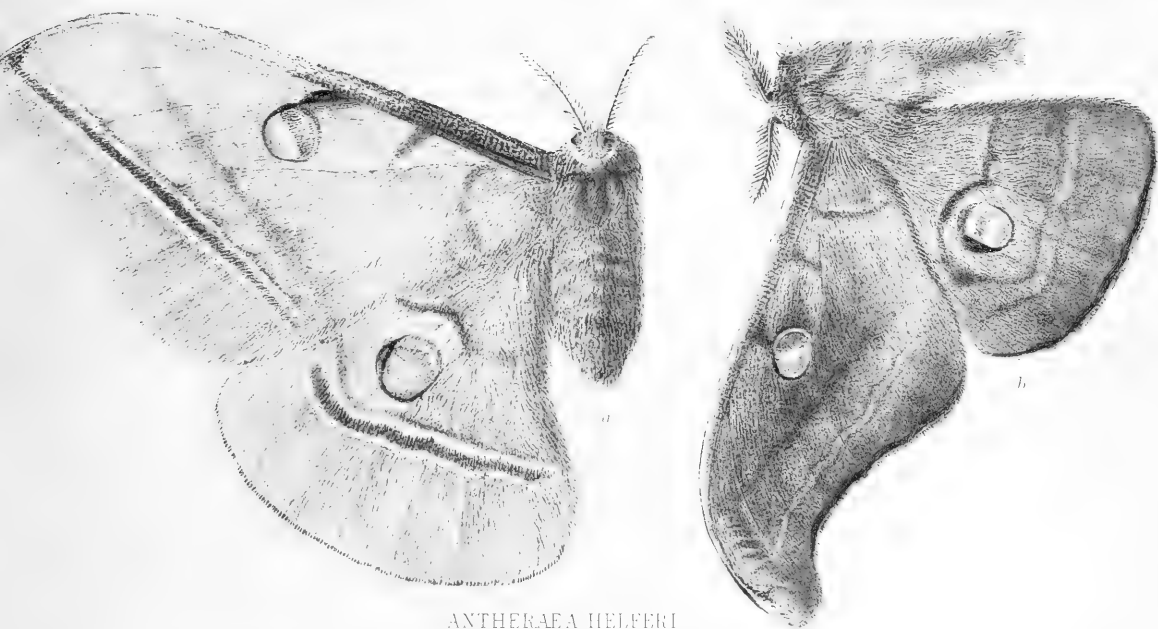
b



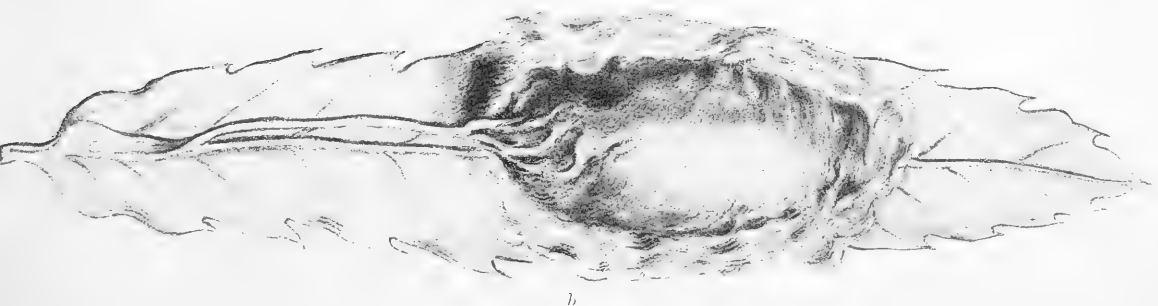
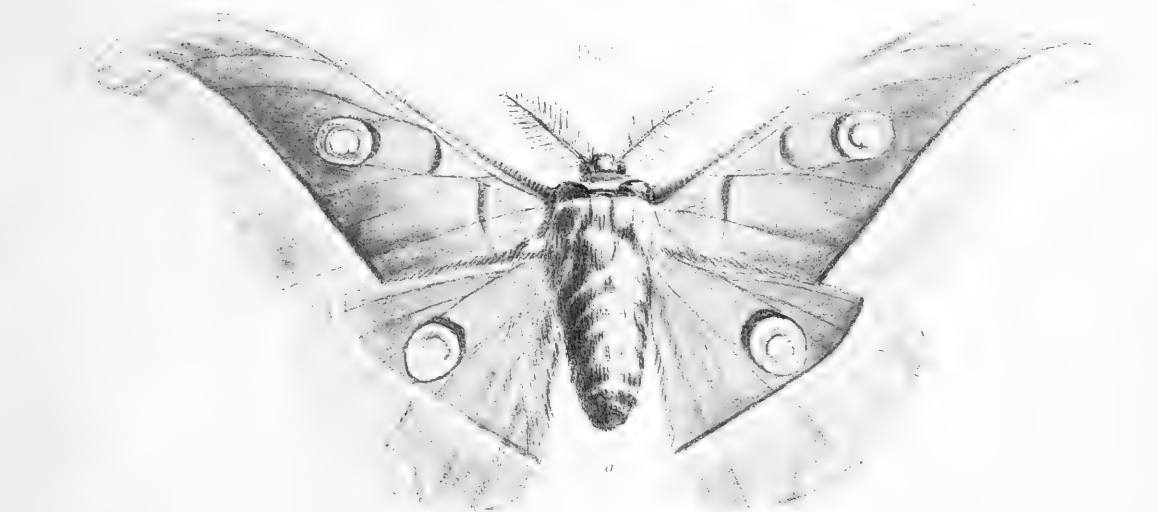
d

ANTHERAEA FRITHII.

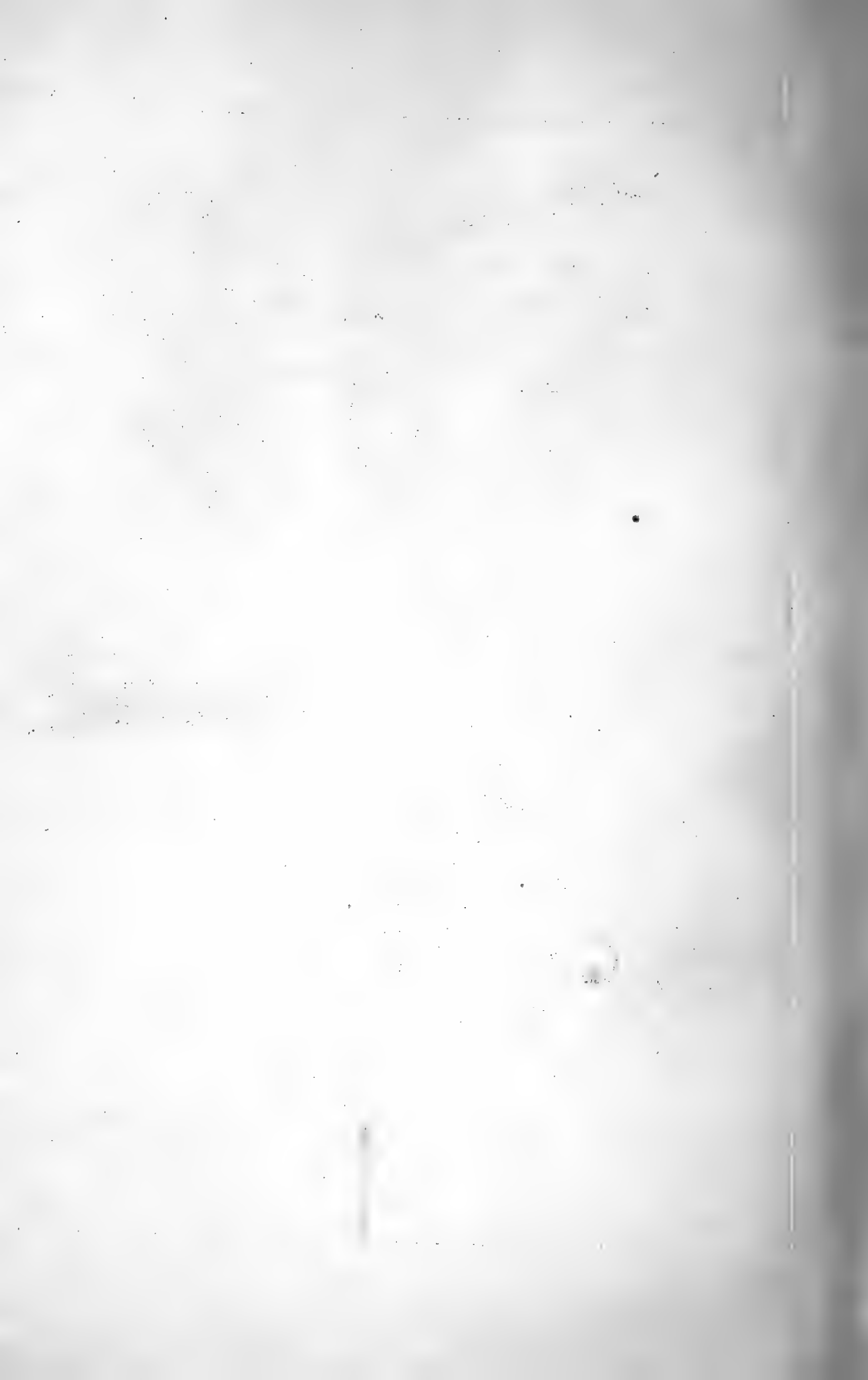
FIG. 1.

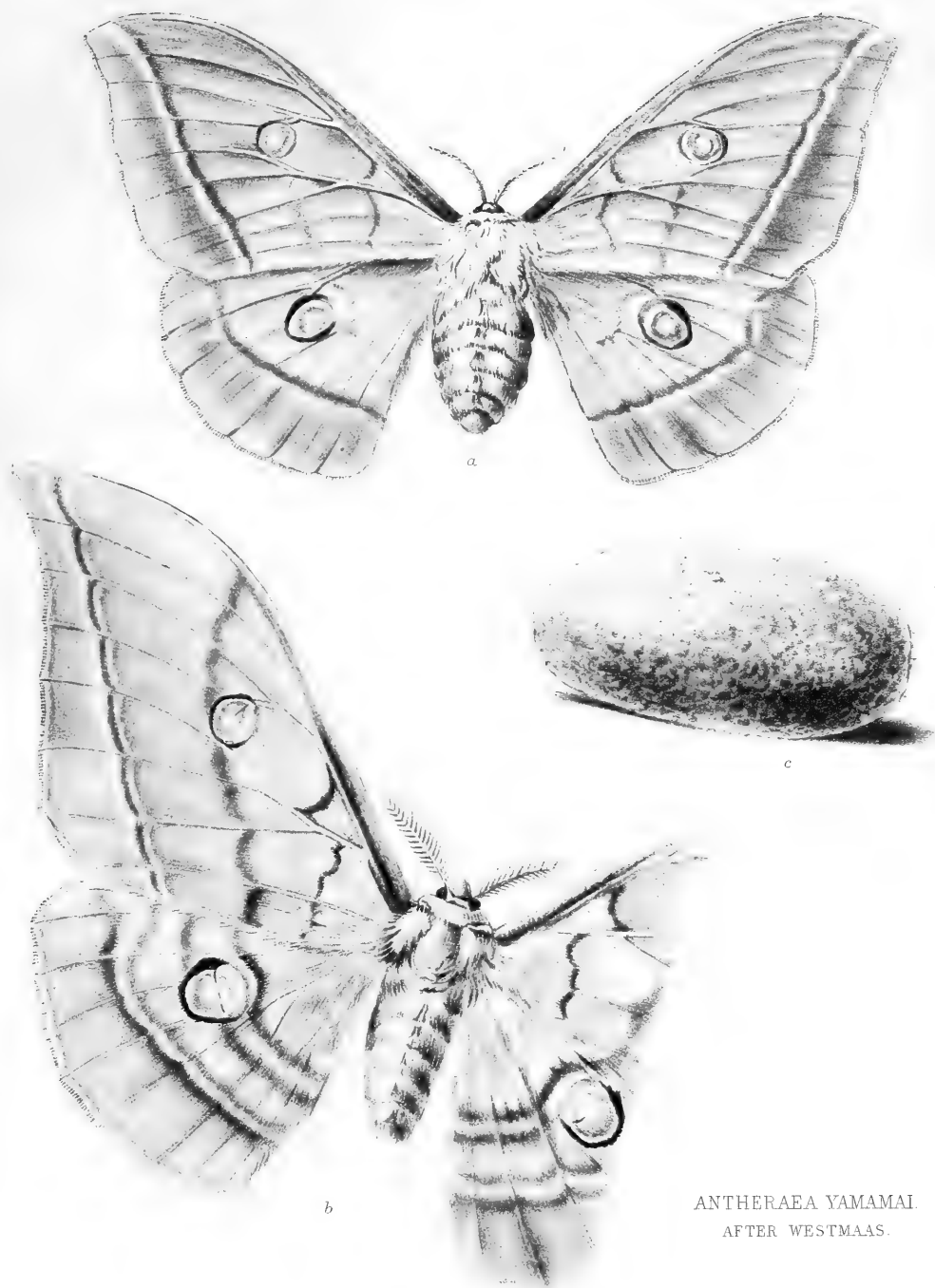


ANTHERAEA HELFERI



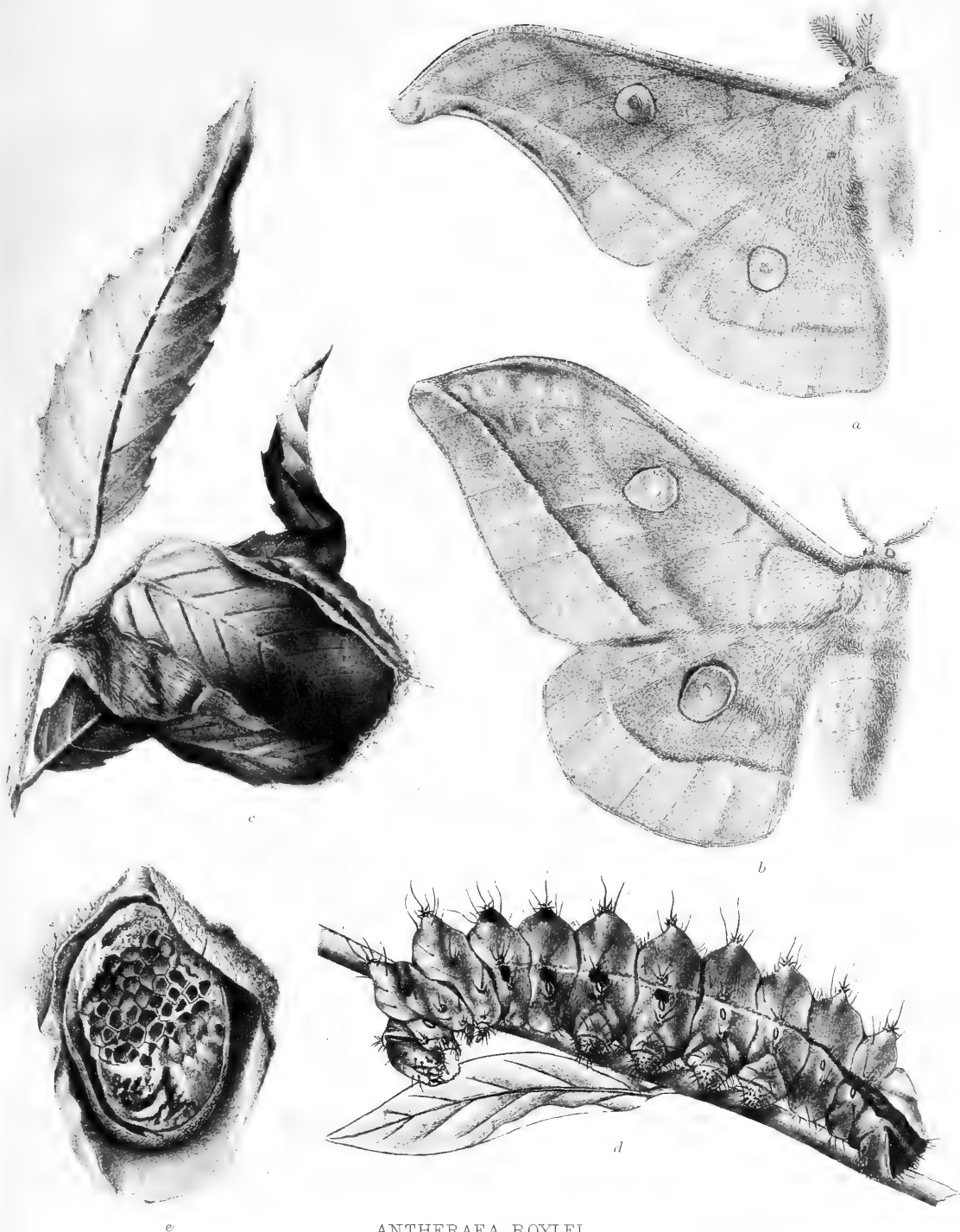
ANTHERAEA PERNYI.
AFTER GUERIN-MÉNEVILLE.





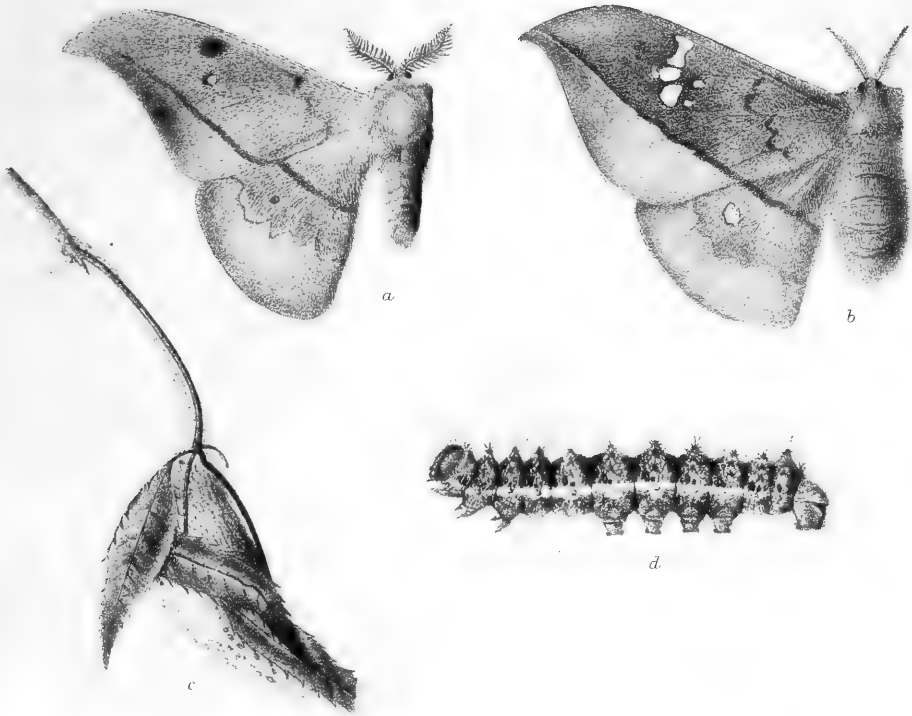
ANTHERAEA YAMAMAI.
AFTER WESTMAAS.





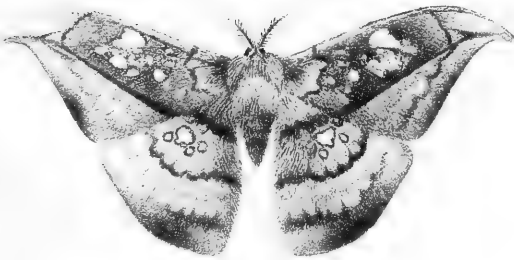
ANTHERAEA ROYLEI.

Fig. 1.



CRICULA TRIFENESTRATA.

Fig. 2.



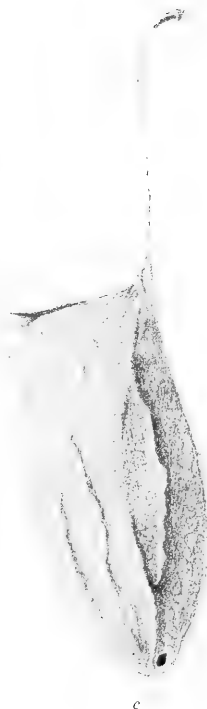
CRICULA DREPANOIDES.

Fig. 3.



OCYNARA LACTEA.

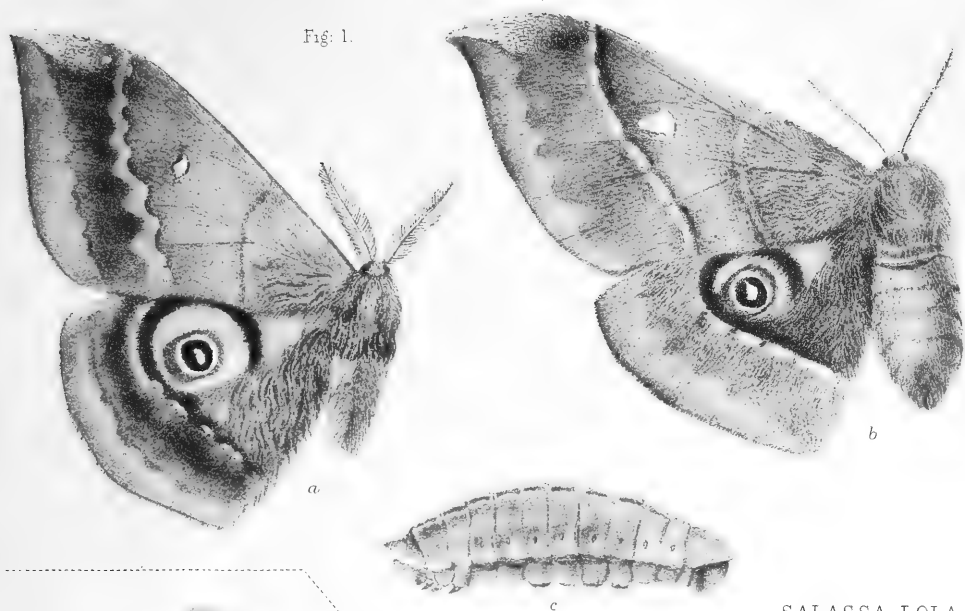




RHODIA NEWARA.



Fig. 1.



SALASSA LOLA.

Fig. 2.



SALASSA ROYI.

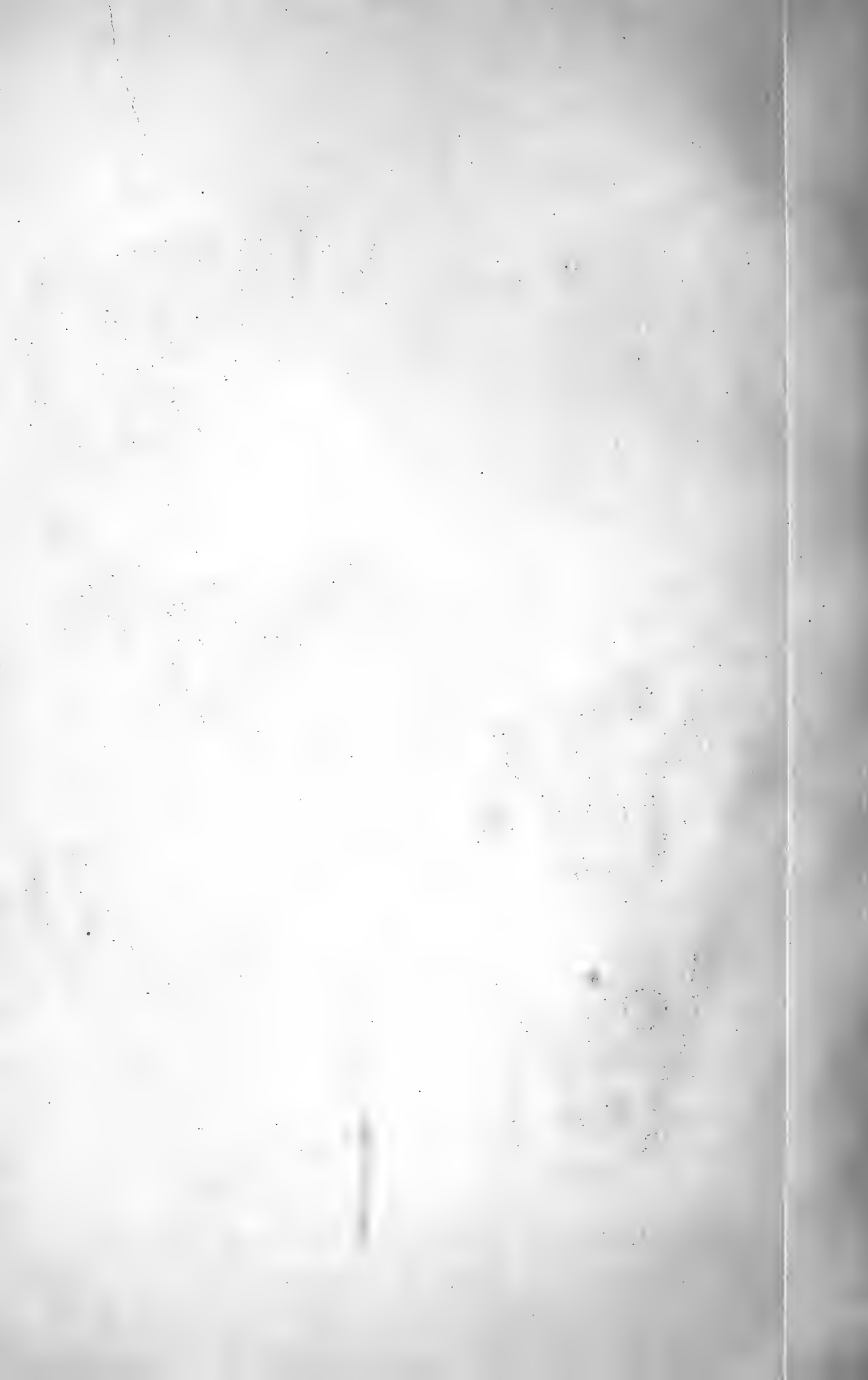


Fig 1.



LOEPPA MIRANDA.

Fig 3.



Fig 2.



NEORIS HUTTONI.

Fig 4.



SATURNIA GROTEI.

SATURNIA STOLICZKANA.



Fig 1.

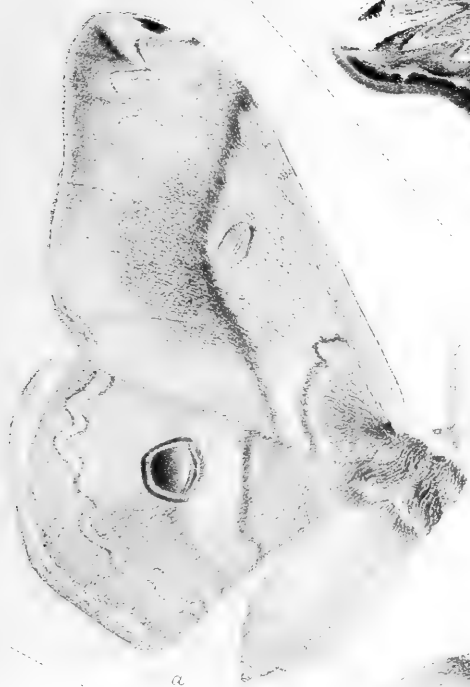
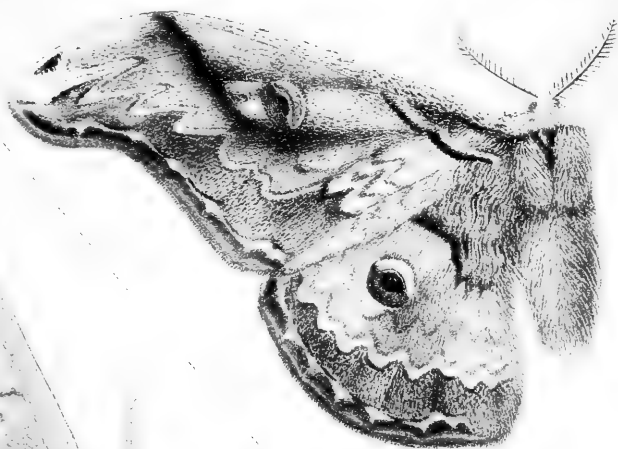
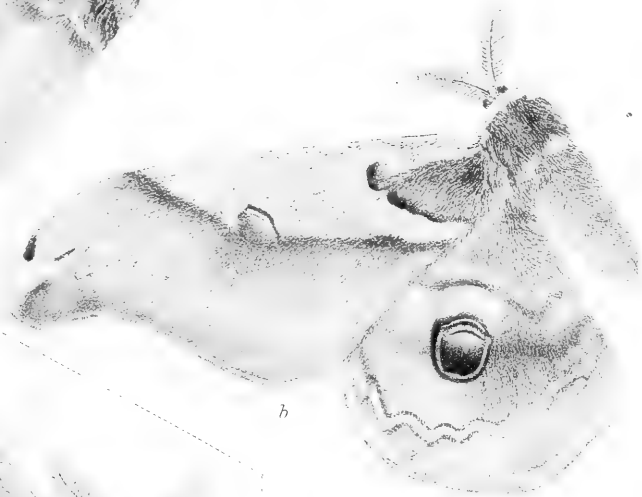


Fig 2.



CALIGULA THIBETA.

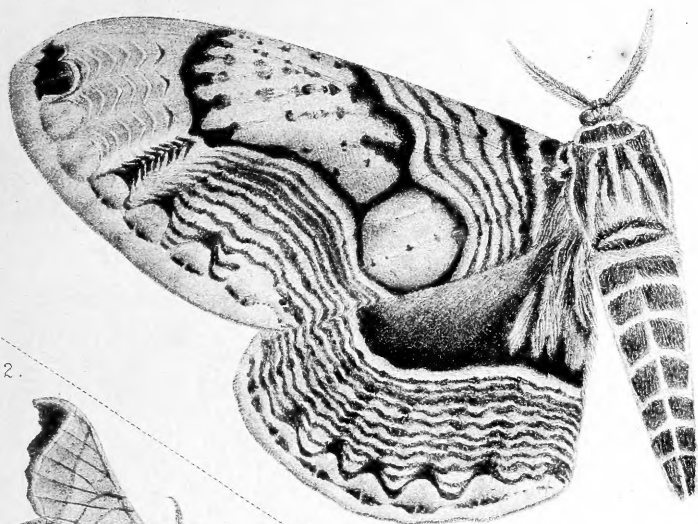
Fig 3.



CALIGULA SIMLA.

RINACA ZULEIKA.

Fig 1.



BRAHMAEA CERTHIA.

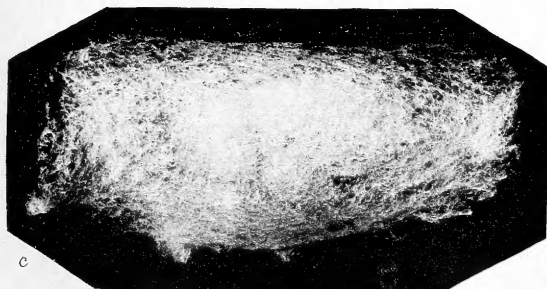
Fig 2.



a



b



c

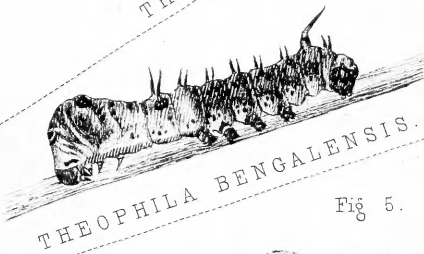
THEOPHILA AFFINIS.

Fig 3.



THEOPHILA HUTTONI.

Fig 4.



THEOPHILA BENGALENSIS.

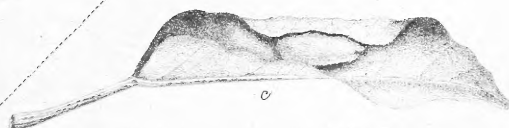
Fig 5.



b



a



c

TRILOCHA VARIANS.

EXPLANATION OF THE PLATES.

- PLATE 2, Fig. 1, *Attacus atlas*,—(a) male; (b) larva; (c) cocoon.
 Fig. 2, *Attacus edwardsii*, larva.
- PLATE 3, *Attacus cynthia*,—(a) female; (b) male; (c) cocoon.
- PLATE 4, *Actias selene*,—(a) female; (b) male; (c) cocoon; (d) larva.
- PLATE 5, *Actias leto*,—(a) male; (b) female; (c) cocoon.
- PLATE 6, *Antheraea frithii*,—(a) female; (b) male; (c) and (d) cocoons.
- PLATE 7, Fig. 1, *Antheraea helferi*,—(a) female; (b) male. These figures are somewhat too dark.
 Fig. 2, *Antheraea pernyi*,—(a) male; (b) cocoon, after Guérin Méneville.
- PLATE 8, *Antheraea yamamai*,—(a) female; (b) male; (c) cocoon, after Westmaas.
- PLATE 9, *Antheraea roylei*,—(a) male, (b) female; (c) cocoon; (d) larva; (e) parasitized cocoon cut across to show the cells made by the Ichneumonid grubs which have destroyed the chrysalis.
- PLATE 10, Fig. 1, *Cricula trifenestrata*,—(a) male; (b) female; (c) cocoon; (d) larva.
 Fig. 2, *Cricula drepanoides*.
- Fig. 3, *Ocinara lactea*,—(a) male; (b) larva, after Hutton.
- PLATE 11, *Rhodia newara*,—(a) female; (b) male; (c) cocoon.
- PLATE 12, Fig. 1, *Salassa lola*,—(a) male; (b) female; (c) larva.
 Fig. 2, *Salassa royi*,—(a) female; (b) male.
- PLATE 13, Fig. 1, *Loepa miranda*.
 Fig. 2, *Saturnia grcei*,—(a) female; (b) male.
 Fig. 3, *Neoris huttoni*,—(a) female; (b) male.
 Fig. 4, *Saturnia stoliczkana*.
- PLATE 14, Fig. 1, *Caligula simla*,—(a) female; (b) male.
 Fig. 2, *Caligula thibeta*.
 Fig. 3, *Rinaca zuleika*.
- PLATE 15, Fig. 1, *Brahmaea certhia*.
 Fig. 2, *Theophila affinis*,—(a) moth; (b) larva; (c) cocoon.
 Fig. 3, *Theophila huttoni*, larva.
 Fig. 4, *Theophila bengalensis*, larva.
 Fig. 5, *Trilocha varians*,—(a) moth; (b) larva; (c) cocoon.

STATE OF NEW YORK

In SENATE,
January 10, 1890.
REPORT
OF THE
COMMISSIONER OF THE LAND OFFICE,
IN ANSWER TO A RESOLUTION
PASSED BY THE SENATE
MAY 10, 1889.

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J. B. LEECH, STATE PRINTER,
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COMMISSIONER OF THE LAND OFFICE,
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